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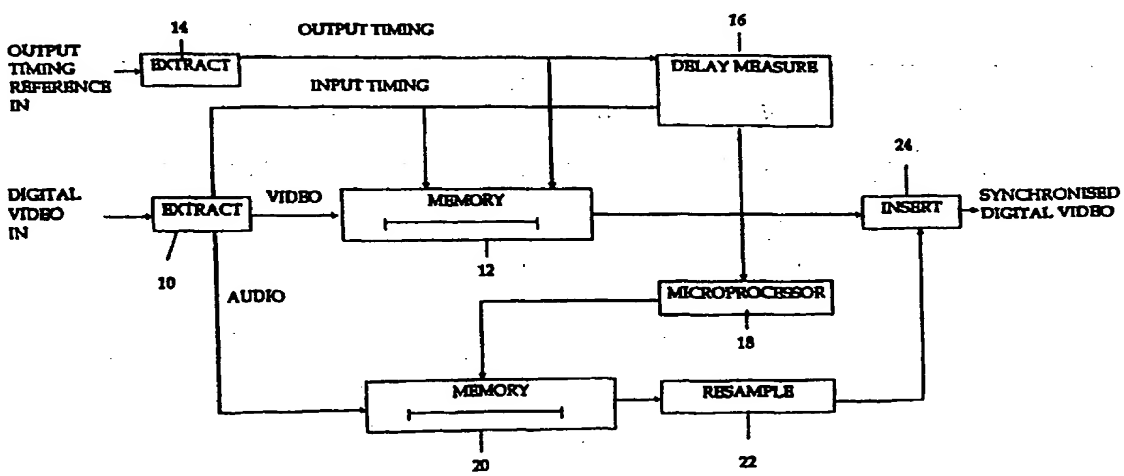

(57) Abstract

In digital video synchronisation, the trend in delay is monitored to enable a prediction to be made of the dropping or repeating of a video field. The audio time compression or expansion is then initiated a selected time interval in advance of the field the dropping or repeating. The loss of audio synchronisation can in this way be kept below perceptible thresholds.

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IMPROVEMENTS RELATING TO AUDIO-VIDEO DELAY

This invention relates to the processing of audio and video signals.

A common problem in the broadcast environment is the difference in delay experienced by the audio and video processes. With many new digital video processes in the signal chain and the consequential need for re-synchronisation, the delay of the video may often differ significantly from that of the audio. This causes the well known lip-sync error problem.

A video synchroniser operates by re-timing and, where necessary, either dropping or inserting fields. Each video synchroniser may therefore add up to 40ms of video delay in a 50 field per second system such as PAL or 34ms in NTSC or other 60Hz systems. The precise delay will depend on often arbitrary system clocks. In new installations the audio is often "embedded" in the video channel and so when passing through the synchroniser it will experience the same delay as the video.

Since a discontinuity of 40ms (or 34ms at 60Hz) is unacceptable in audio, a temporary loss of lip sync is inevitable. In order to recover lip sync, the audio signal is time compressed or expanded for a period of time. This period of time must be sufficiently long that the resultant pitch change or other degradation remains imperceptible and will amount to several seconds. Over these several seconds, the loss of lip sync can be seriously objectionable.

It can be shown that a loss of synchronisation in which the audio arrives early, is particularly noticeable. It has been suggested that in the case of the audio being earlier than the video a delay much above 10ms is perceptible. In the opposite sense, with the audio being delayed, a delay of up to 30ms may be tolerated.

It is an object of the present invention to provide an improved method of managing differential delay of digital audio and video signals.

Accordingly, the present invention consists in one aspect in a digital video synchronisation process in which digital video and audio signals are delayed by the same varying amount to ensure synchronisation with a timing reference and, on dropping or repeating of a video field, the audio signal is time compressed or expanded to recover audio/video synchronisation over a time period governed by the maximum acceptable pitch change or other

degradation, characterised in that the trend in delay is monitored to enable prediction of the dropping or repeating of a video field and in that said time compression or expansion is initiated a selected time interval in advance thereof.

In one form of the invention, this time interval is selected to minimise the perceived loss of audio/video synchronisation. That is to say, regard is had to the asymmetry in the thresholds for perceived loss of synchronisation for advanced and retarded audio.

The invention will now be described by way of example with reference to the accompanying drawing which is a block diagram of a digital video synchroniser according to the invention.

The video synchroniser shown in the drawing receives a digital video input signal with embedded audio and provides as an output synchronised with an externally generated timing reference, a digital video signal, again with embedded audio.

Digital video first passes into block 10; this extracts the audio data and the timing signals. Video passes to the main memory 12 to be delayed until it is co-timed with the output timing signal extracted by block 14 from the reference input. Block 16 measures the delay between the input and output timing signals and passes this figure to a microprocessor 18. The calculated delay is passed to the audio data memory 20. The audio data and video data memories now give an identical delay. A re-sampling digital filter 22 alters the audio data sampling rate to match the outgoing video in order that the audio data can be synchronously inserted by block 24 into the outgoing video data stream.

A synchroniser such as this, when its input and output timing references are of a different frequency, as is usual, will occasionally drop or repeat a video frame. In effect, it gains or loses 40ms (at 50Hz). Whereas the resulting picture disturbance is often imperceptible, the same is not true for audio - it is not possible to cut or add 40ms of audio without major disturbance.

A typical implementation will compensate by re-sampling the audio to a higher or lower frequency. In the case where the video memory has lost a

frame, the microprocessor 18 will initiate a process of reading extra audio samples from the audio memory 20. A pitch change results, but if this is kept to less than 1%, it is unlikely to be noticed. Thus, after a synchroniser drops or repeats a frame the audio will initially be adrift by a noticeable 40ms. After 8 seconds (assuming 0.5% pitch change) the audio and video will once again be co-timed. As a result, there will be a perceptible error for up to 6 seconds.

In the improved system according to this invention, the microprocessor 18 will continually monitor the video delay and calculate the rate of change of delay over time. With the highly stable timing references that are generally in use, it will usually be possible to predict accurately the time that the video memory will drop or gain a frame. Where it is predicted that, at the current rate of change, a video frame is due to be lost in 6 seconds time, the processor will initiate an increase in the audio delay to give a 0.5% pitch change. Just before the frame loss, the audio will be 30ms (at 50Hz) delayed with respect to the video. If the above discussed thresholds for perception of an audio delay are correct, this loss in synchronisation is imperceptible. Immediately after the frame loss the audio will be 10ms early. If the above-discussed thresholds for perception of an audio advance are correct, this loss in synchronisation is similarly imperceptible. After a further 2 seconds, the audio and video will be co-timed. Of course, the pitch change and the balance between worst case advance and delay may be controlled by the user. Use of the invention has in this example and on the assumed perception thresholds, replaced a synchronisation error which is perceptible for up to 6 seconds, by a synchronisation error which is not perceptible at all.

When it is predicted that, at the current rate of change, a video frame is due to be repeated in 2 seconds time the processor will initiate an decrease in the audio delay to give a 0.5% pitch change. Once again the error will be imperceptible.

It will be understood that the invention has been described by way of examples only. Thus, rate conversion is only one example of a technique for time compression or expansion of the audio signal. Numerous alternative techniques, such as silence compression, will be known to the skilled reader and fall within the scope of the claimed invention.

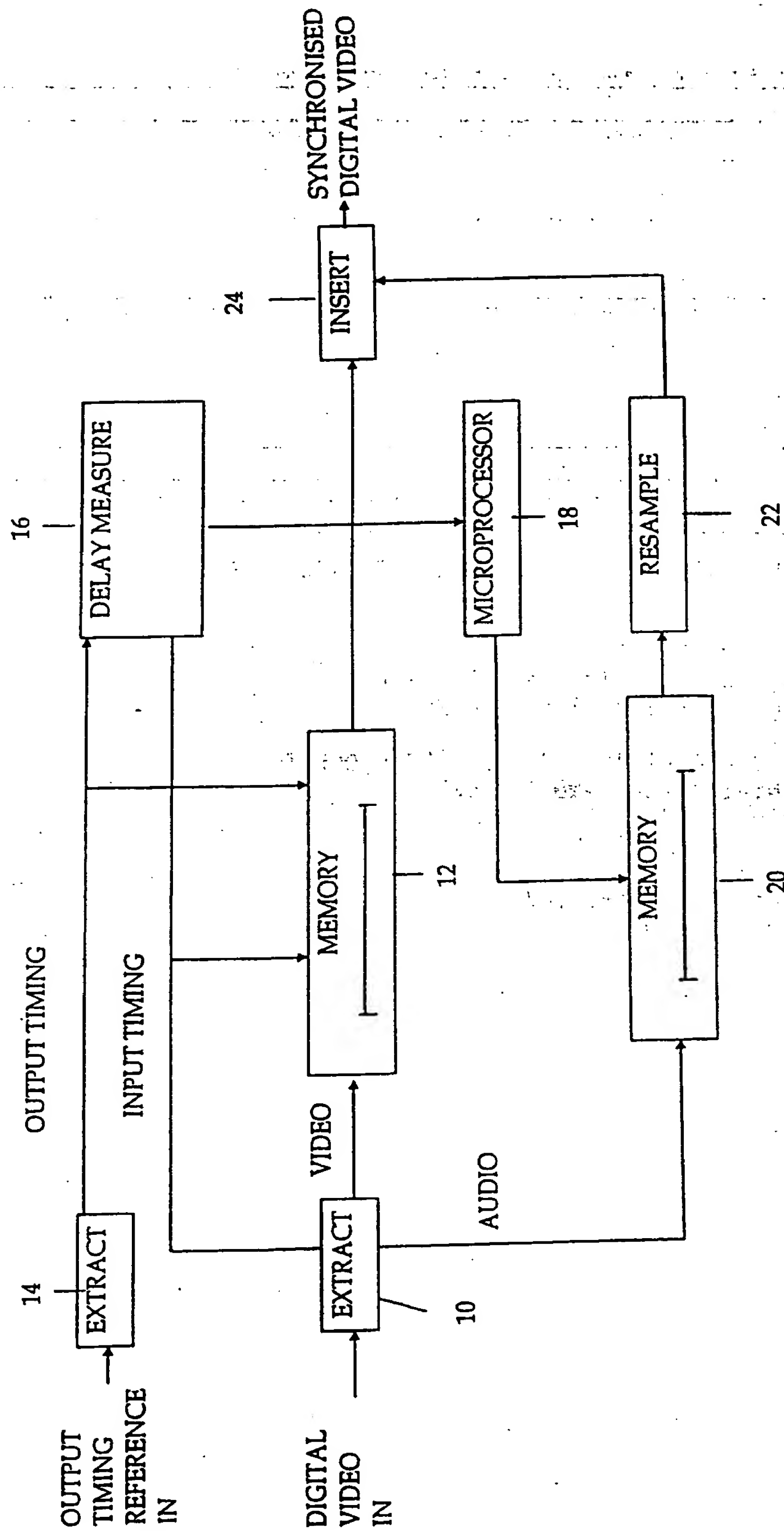
CLAIMS

1. A digital video synchronisation process in which digital video and audio signals are delayed by the same varying amount to ensure synchronisation with a timing reference and, on dropping or repeating of a video field, the audio signal is time compressed or expanded to recover audio/video synchronisation over a time period governed by the maximum acceptable pitch change or other degradation, characterised in that the trend in delay is monitored to enable prediction of the dropping or repeating of a video field and in that said time compression or expansion is initiated a selected time interval in advance thereof.

2. A process according to Claim 1, wherein said time interval is selected to minimise the absolute loss of audio/video synchronisation.

3. A process according to Claim 1, wherein said time interval is selected to minimise the perceived loss of audio/video synchronisation.

4. A process according to Claim 3, wherein said time interval is selected such that the period for which the audio is delayed with respect to the video is greater than the period the period for which the audio is advanced with respect to the video.


OUTPUT TIMING REFERENCE IN
EXTRACT
14
DIGITAL VIDEO IN
EXTRACT
10
OUTPUT TIMING
INPUT TIMING
VIDEO
AUDIO
DELAY MEASURE
16
MEMORY
12
MICROPROCESSOR
18
MEMORY
20
RESAMPLE
22
INSERT
24
SYNCHRONISED DIGITAL VIDEO

INTERNATIONAL SEARCH REPORT

Inter. ›nal Application No
PCT/GB 99/01041

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IPC 6 H04N7/52

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 H04N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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A	KIRBY D G ET AL: "A NEW TECHNIQUE TO MAINTAIN SOUND AND PICTURE SYNCHRONISATION" EBU REVIEW- TECHNICAL, no. 264, 1 January 1995 (1995-01-01), pages 13-21, XP000670474 ISSN: 0251-0936 paragraph '0003! figures 2,3 --- -/--	1-4

[X] Further documents are listed in the continuation of box C.

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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

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Information on patent family members

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